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DATE: May 5, 1960

SUBJECT: WHITE OAK CREEK DRAINAGE SYSTEM

TO: F. R. Bruce

FROM: F. L. Culler

Abstract

A new channel for White Oak Creek from its junction with Melton Branch to a point below White Oak Dam is proposed to: (1) provide secondary containment for the radioactivity in the Waste Disposal Pits; (2) provide emergency impoundment for contaminated ORNL process waste water; (3) reduce scouring of radioactive mud from the dam basin by heavy rains; and (4) reduce the danger of a failure of White Oak Dam.

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WHITE OAK CREEK DRAINAGE SYSTEM

The existing Laboratory waste system consists of (1) nineteen 1000-4000-gallon stainless steel hot chemical waste collection tanks which discharge to (2) six 170,000-gallon concrete waste storage tanks, (3) four shale seepage pits for disposal of hot waste supernates, (4) a 750,000 gallon equilization basin, and (5) a 500,000-gallon-per-day lime-soda treatment plant for low-level wastes, and (6) a 1,500,000-gallon settling basin for process waste water and very low-level wastes and associated pumps and piping. The release of aqueous waste from the Laboratory settling basin is via White Oak Creek through the White Oak Lake bed and dam and thence to the Clinch River about 1 mile below White Wing Bridge. Wastes from the settling basin and treatment plant are monitored and their release controlled to minimize the amount of activity discharged to the environment. An average of 800,000 gallons are released daily. However, discharge of residual activity from the White Oak Lake basin and the seepage pits is only semicontrolled, and it is extremely likely that much of the radioactivity now appearing in the Clinch and Tennessee Rivers comes from leaching and scouring of the mud behind White Oak Dam. One of the most serious aspects of the Laboratory's waste problem would be the sudden release of gross activity from the lake bed and the seepage pits which could happen if a storm of the severity of one which occurred on September 29, 1944, recurred (8 in. of rain in 24 hours).

Historically, White Oak Dam was constructed in 1943 to provide a temporary impoundment and dilution area for very low-level wastes produced by the original X-10 Pu pilot plant operations and allied and subsequent activities. The basin was used for 12 years in this fashion, during which time considerable activity settled to the lake bottom. In 1955 the lake was drained to provide an emergency holdup volume of 4.3 to 20,000,000 cubic feet[1] depending on the gate setting in White Oak Dam. The lake has been kept relatively empty since then; however, White Oak Creek still flows through the bed. Water which now collects in the lake is predominantly backup from Watts Bar Lake; to eliminate this backflow, work is currently in progress to raise the lower gate in the dam 5 feet to elevation 742.

It is estimated that from fifteen to several hundred to a thousand curies of Sr-90 activity plus considerable amounts of other fission products are deposited in the soil of the lake bed; the former, however, represents the hazard of greatest significance. The four seepage pits which are about 80 feet above the elevation of the lake bed are known to contain about 400,000 curies of mixed fission product activity of which 280,000 curies were contributed in 1959. It is known that the Sr-90 is fixed to the clay; however, other species, particularly Ru, have leaked through the formation and have been discharged to the environment.

The data in Table 1 point out that during the period 1954 through 1959 the amount of Sr-90, and almost certainly other activities, discharged through White Oak Dam consistently exceeded the amounts known to have been released in current Laboratory waste by factors of 1 to 10; the over-all excess of Sr-90 for the last seven years was 424 curies. Further, it is known that the leak in seepage pit #4 discharged 300-500 curies of Ru activity to White Oak Creek, before the leak was contained and further leakage returned to the pit.

[1] Studies of White Oak Creek Drainage System, ORNL-562.

Thus it appears that regardless of the degree of control which is exerted over the discharge of waste from the local plant area, a serious hazard exists in the present system in Melton Valley which could in the event of a flash flood dump embarrassing amounts of activity into the Clinch and Tennessee Rivers. This is of especial significance since U.S. Public Health Service surveys show that Chattanooga's raw drinking water taken from the Tennessee River 125 miles downstream from ORNL has the highest radioactive strontium content of any drinking water in the United States. The level at Chattanooga is about 5% of the MPC for lifetime exposure to the general population.

The most serious events that could occur in the event of a flash flood, in order of severity, are (1) washing out of the steep east bank of seepage pit #4 and (2) the collapse of White Oak Dam. During the flash storm of September 1944 two dikes, constructed above the dam early in 1944, were washed out and the level in the lake rose to 753 ft, three feet above the top of the dam spillway. At the time of this occurrence the dam was newly constructed and undoubtedly in good repair. It is conceivable that another severe rainfall could wash out the dam, which is actually a road fill rather than a carefully designed and constructed dam. The normal flow of White Oak Creek at the dam is 7.5 cubic feet of natural watershed drainage plus 9 cubic feet of cold plant waste water per second (11 million gal/day). Since the White Oak Creek watershed has an area of about 6 sq miles, the total amount of water which would run off in a storm of the severity of the one in September 1944 (8 in. of rain) could be as high as 110 million cubic feet if the rain were uniform over the entire watershed. Thus, the present lake bed would be completely filled in about four hours. The turbulence created by this flow would undoubtedly release a large fraction of the Sr-90 containing mud and silt in the basin with an even greater release if the dam were to fail.

Based on these data it is our opinion that a real and apparent danger exists with the present Melton Valley system which the proposed 3,000,000-gallon diversion basin, described later, only partly eliminates. Therefore, we think that the feasibility and cost of a diversion channel capable of handling a maximum flow of 1200 cubic feet per second from below the confluence of White Oak Creek and Melton Branch to below White Oak Dam (about one mile) on the south bank of the lake bed should be determined. Concurrently the cost differential between running pipe line to the proposed new 3,000,000-gallon emergency basin versus to the existing White Oak basin should be established. With this arrangement all but one-half square mile of the White Oak Creek watershed would be diverted through the new channel. The existing basin, which would receive only natural drainage from the hazardous north bank, which contains the seepage pits, and the plant outflow under unusual or emergency conditions would be capable of (1) holding back the runoff from a storm of up to 18 in. of rain or (2) containing all plant waste for about six months (188 days). Under combination circumstances, the basin could hold the 9,300,000 cubic feet of runoff for a rainfall equivalent to the storm of September 1944 plus emergency holdup of plant waste for about 100 days without overflowing.

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TABLE 1

Comparison of Radioactivity Discharged from ORNL to Creek with Radioactivity Passing Through Dam to River

Year	Curies of Strontium to White Oak Creek	Curies of Strontium thru Dam
1953	122	132
1954	59	135
1955	50	92
1956	45	100
1957	34	83
1958	14	147
1959	19	78
Total	343	767

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